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(56) Documents Cited
GB 2352939 A EP 1102509 A1
WO 2000/076171 A
ETSI TS 100 927 V6.7.0 (2001-06) see whole specification, especially sections 2 and 3
ETSI TS 123 003 V4.3.0 (2001-12) see whole specification, especially sections 2 and 3

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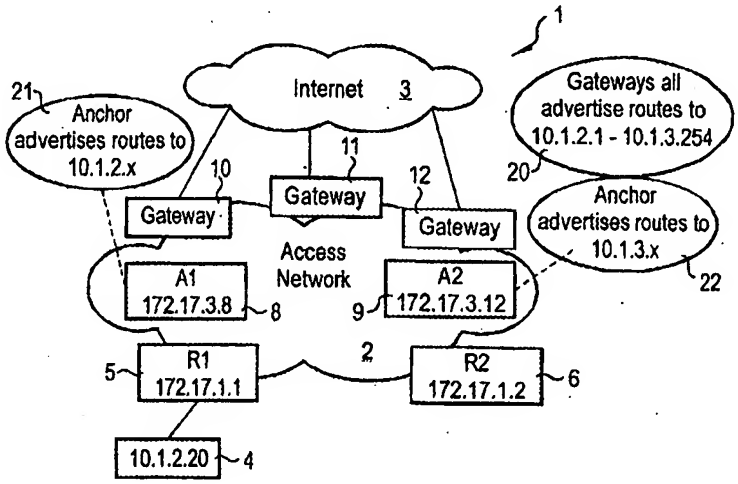
(54) Abstract Title

Readdressing a packet transmitted by a roaming mobile subscriber unit in order to reduce required signalling

(57) A communication network 1 includes a number of network nodes, including anchor nodes 8 and 9, access nodes 5, 6, gateway nodes 10, 11 and 12 and mobile nodes 4 (mobile subscriber unit, node b, or mobile phone). When a mobile node accesses the network it is allocated a network address and a specific anchor node is assigned to support connections to the mobile node. The specific anchor node advertises this so that nodes wishing to direct packets to the mobile node 4 do so by directing the to the specific anchor node. When the mobile node 4 transmits a packet to the network via an access node, the access node encapsulates the packet with a header including as the destination the mobile node's address, which is then automatically routed to the anchor node assigned to the mobile node. The anchor node then de-encapsulates the packet and transmits the original packet to the network and on to its desired destination. This automatic routing to the specific anchor node reduces the signalling required to update the network as the mobile node moves across the network.

FIG 2



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At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

FIG 1

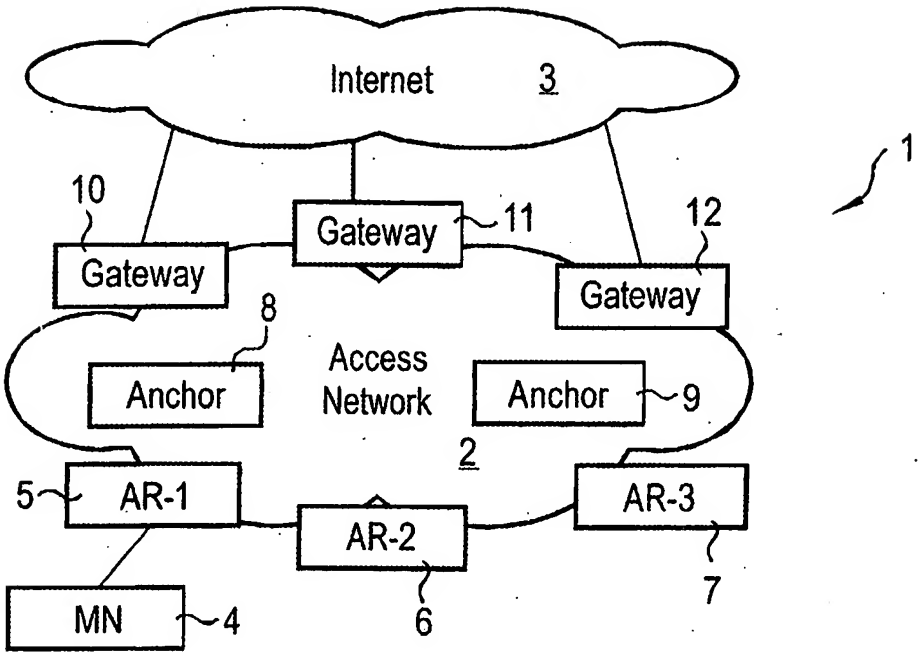

Internet 3
1
10
Gateway
11
Gateway
12
Gateway
8
Anchor
Access Network
Anchor
9
2
5
AR-1
AR-2
AR-3
MN
4
6
7

FIG 2

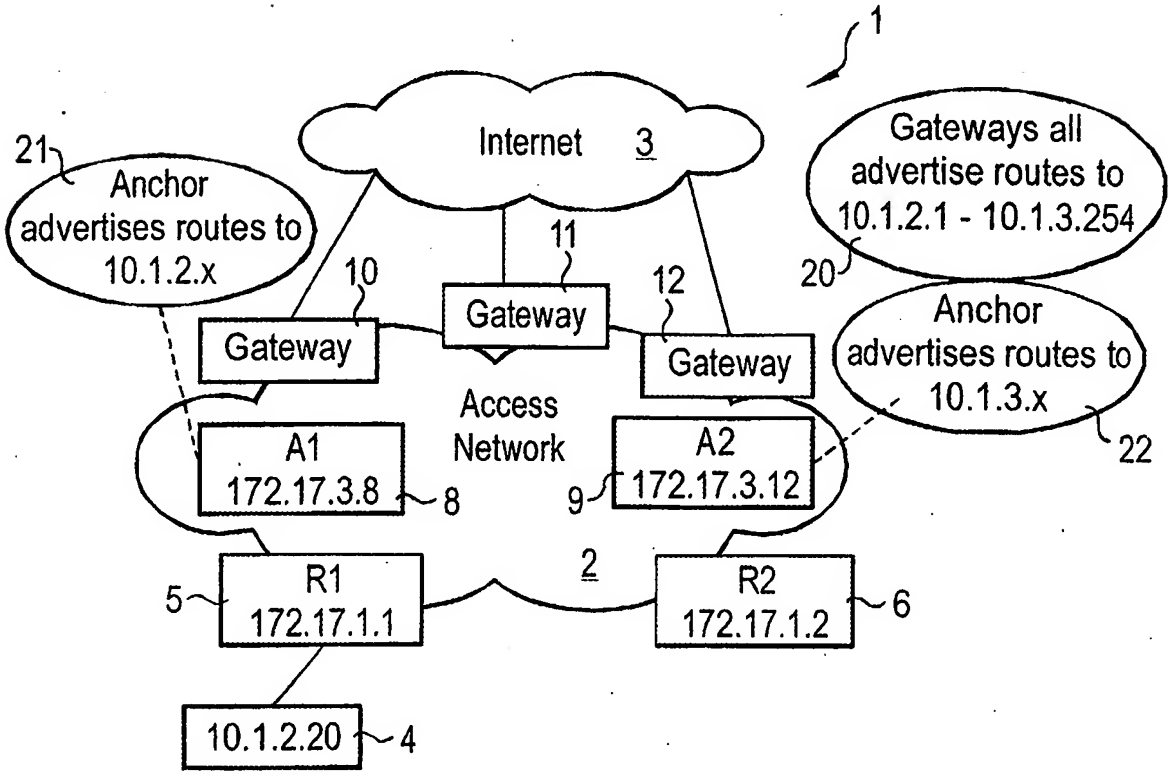

1
Internet 3
21
Anchor advertises routes to 10.1.2.x
Gateways all advertise routes to 10.1.2.1 - 10.1.3.254
20
10
11
12
Gateway
Gateway
Gateway
Anchor advertises routes to 10.1.3.x
22
Access Network
A1
172.17.3.8
8
A2
172.17.3.12
9
2
5
R1
172.17.1.1
R2
172.17.1.2
6
10.1.2.20
4

FIG 3

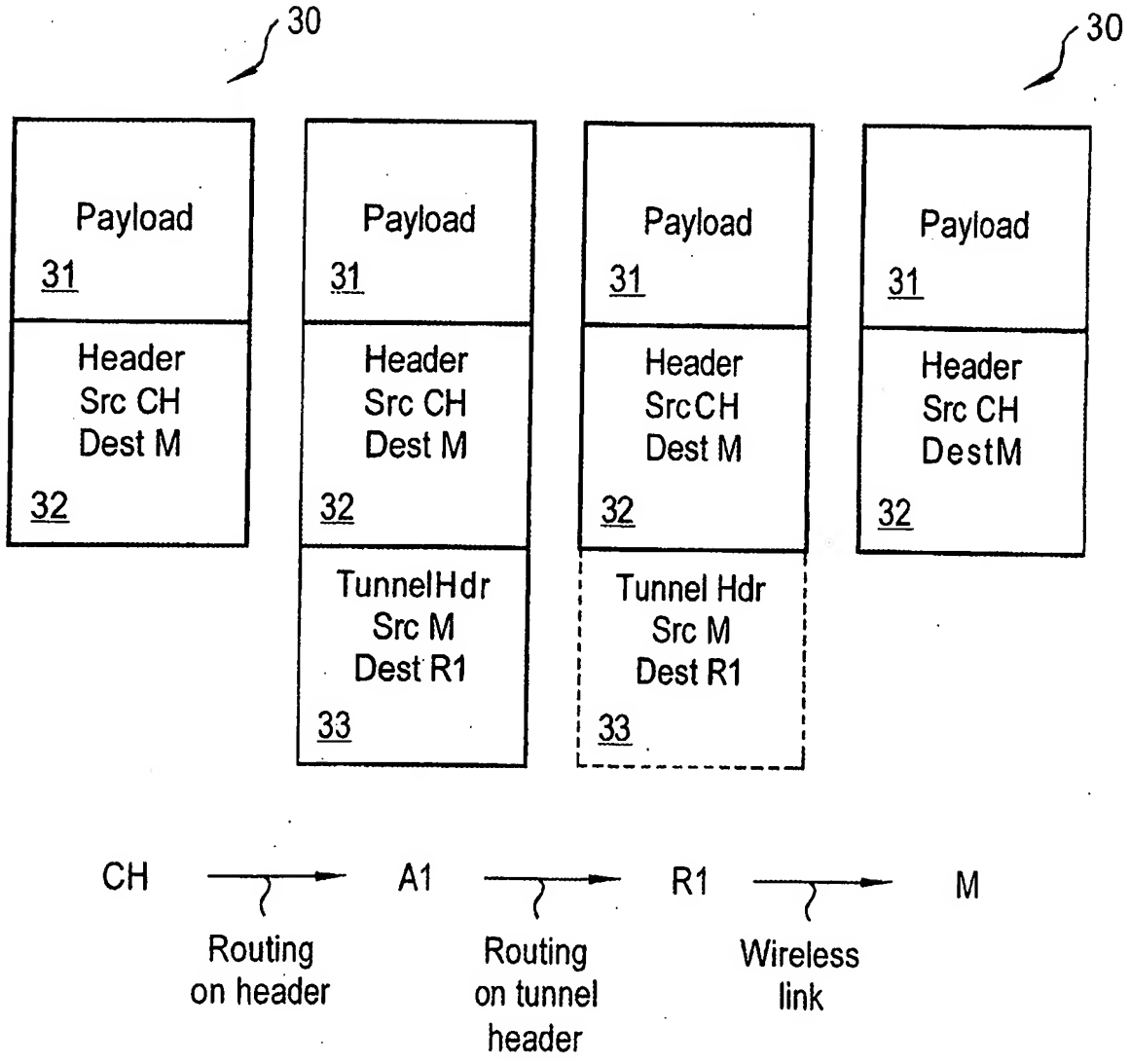
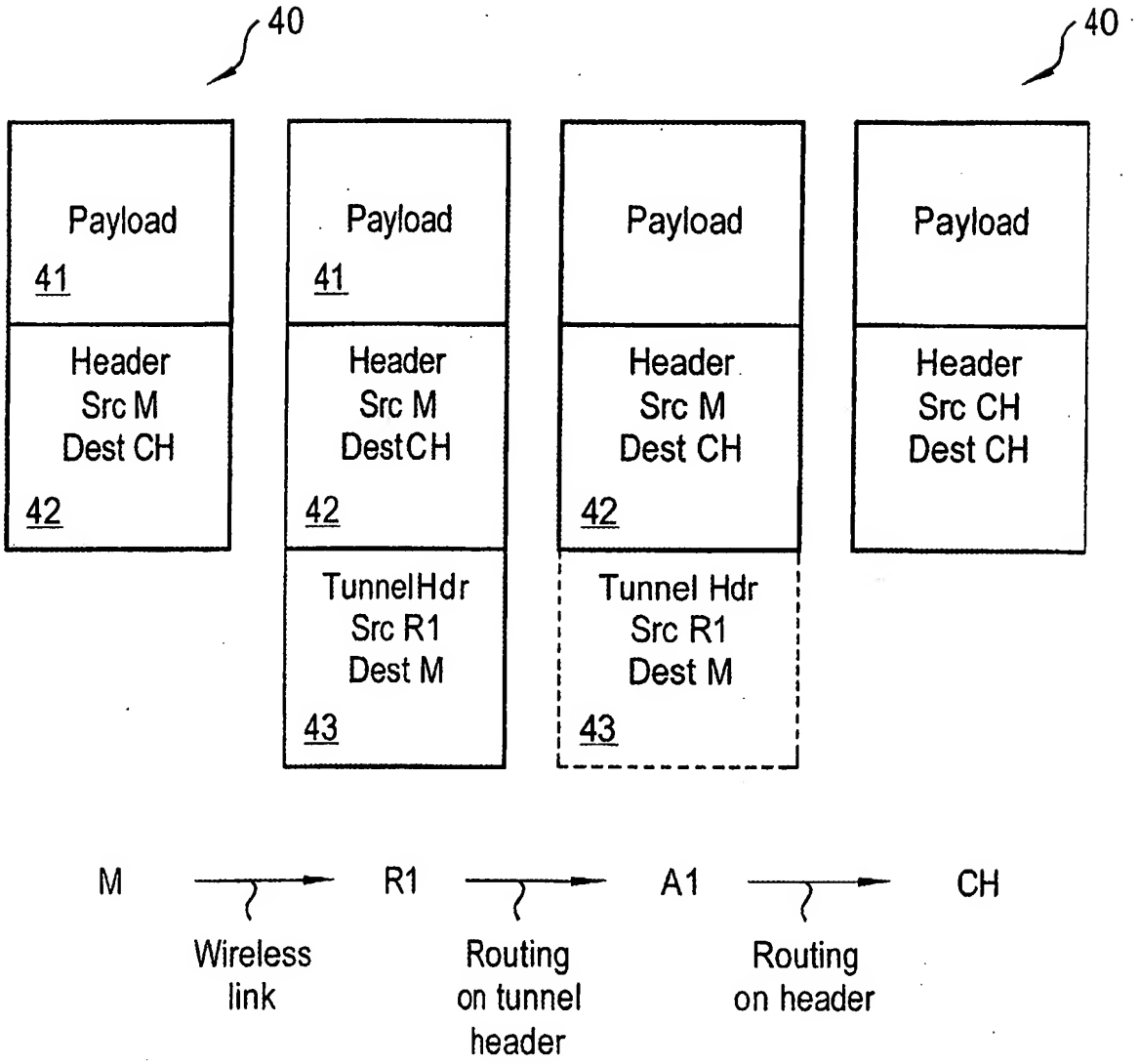

30
30
Payload
31
Header
Src CH
Dest M
32
Payload
31
Header
Src CH
Dest M
32
TunnelHdr
Src M
Dest R1
33
Payload
31
Header
SrcCH
Dest M
32
Tunnel Hdr
Src M
Dest R1
33
Payload
31
Header
Src CH
DestM
32
CH
A1
R1
M
Routing
on header
Routing
on tunnel
header
Wireless
link

FIG 4



Note: because M is only reachable through routes advertisedbyA1,apackettunnelledto M will reachA1usingstandardrouting on the tunnel header

A communications apparatus and method

This invention relates to a communications apparatus and method. In particular it relates to packet based networks supporting mobile terminals.

Mobile terminals are termed in the art mobile nodes since they form a node in a network although the node is not fixed because the mobile is able to move geographic location. The most familiar example of a mobile node (MN) is a mobile telephone. Another example is a laptop computer.

As will be appreciated, in order for calls to be set-up across a network to a mobile node it will be necessary to have a knowledge of where the mobile node connects to the network (the connection being made via a so-called access router). In a fixed node network, a host is generally allocated an address based implicitly on its topographical location which makes routing straightforward. In a network that supports mobile nodes the situation is more complex as the address of the mobile will change as it connects to different access nodes. It is desirable to avoid having to change the mobile node's address as it moves location because this will cause an increased signalling activity or "overhead". This results in communication resource being used for signalling rather than for carrying useful data or "traffic"

In order to reduce the signalling required it is known to provide a so-called "anchor-node" sometimes referred to as a mobility agent. The anchor-node is a node in the network which has the function of recording the current network location of a mobile node. The anchor node will advertise to the rest of the network that it caters for nodes within a certain range of addresses. A problem with this arrangement is that every node in the network has to be aware of the anchor address including the mobile node and in the event of an upgrade or failure of the system it is difficult to recover this distributed knowledge.

According to the invention there is provided a communications network formed of interlinked network nodes the nodes including fixed nodes, at least one anchor node and, in use, at least one mobile node, at least one access node for facilitating connection of the mobile node to the network, means for allocating to the mobile node a network address, means for allocating addresses to particular anchor nodes, wherein the access node receives packets from the mobile node and encapsulates the packet in a packet having a header which shows as a destination address the address of the mobile node.

The invention also provides a method.

A specific embodiment of the invention will now be described by way of example only with reference to and as illustrated by the drawing in which:

Figure 1 shows a communications network in accordance with the invention;

Figure 2 shows the network of figure 1 and gives detail of the allocation of network addresses; and

Figures 3 and 4 are explanatory figures

As is shown in figure 1, a communications network 1 comprises an access network 2 inter-operating with the Internet 3 and a mobile node 4 (in practice there will be very many mobile nodes not just the one depicted). The access network 2 includes a number of network nodes. The access network nodes include access router nodes 5 to 7, anchor nodes 8 and 9, and three gateway

nodes 10 to 12. The gateway nodes connect the access network to the Internet. The mobile node 4 is, for example, a mobile telephone and it connects to the access network via the access routers 5 to 7. In the figure it is depicted as connected to the access router 5. As the mobile node 4 moves (in geographical terms) it will undergo a handover process to connect to one of the other access routers 6 or 7. The handover process will be familiar to a person skilled in the art of cellular communications.

In order to allow a user of the mobile node to browse the Internet a connection is made via the gateway nodes 10 to 12.

The anchor nodes 8 and 9 are nodes that provide certain functionality to support the mobility of the mobile node 4. The anchor nodes each have a responsibility for routing to sub-nodes in a particular address range. When a mobile node connects to the access network it will be allocated an IP address in a range supported by an anchor (IP being an abbreviation for Internet Protocol). The anchor maintains a mapping from the allocated IP address to the actual location of the mobile node and it is relatively straightforward for downlink traffic to be passed to the mobile. This is due to the anchor node "advertising" to the other network nodes that it can send messages on to certain addresses. A packet destined to the mobile node 4 will be first sent to the anchor node, it will then be encapsulated in an IP address to the access router 5. The packet is then "tunnelled" to the access router, the original packet extracted and forwarded to the mobile node 4. The anchor node can be thought of as holding a virtual copy of the mobile node.

The way in which the network operates will be further explained with reference to a detailed example illustrated by figure 2. In the example, the access network provides routes to mobile nodes with addresses in the range 10.1.2.1 to 10.1.3.254. This is "advertised" by the gateway nodes 10 to 12 to the Internet in message 20. The anchor node 8 having address 172.17.3.8

advertises in message 21 that it owns routes to addresses 10.1.2.1 to 172.1.2.254 with metric 1. Anchor node 9 having address 172.17.3.12 advertises in message 22 that it owns routes to mobiles having addresses in the range 10.1.3.1 to 10.1.3.254 with metric 1 and in the range 10.1.2.1 to 10.1.2.254 with metric 2.

The access routers 5 and 6 have addresses 172.17.1.1 and 172.17.1.2 respectively and when the mobile node 4 attaches to the network via the access router 5 it is allocated the address 10.1.2.20 in accordance with the network protocol. As the mobile node 4 interacts with the services operating on the Internet this address is registered with the services. Packets for the mobile node 4 are then sent to the anchor 8 via the best available route. The anchor 8 then encapsulates the packets to tunnel them to access router 5. The packets are then de-encapsulated and sent to the mobile node 4. This encapsulation and de-encapsulation process is shown in figure 3. In a first step the packet 30 is formed with a payload 31 and a header 32 by the originating node and placed on the downlink channel "CH". The header 32 includes source information "Src" and destination information "Dest". In this case the source is CH and the destination is the address of the mobile node denoted as "m" in the figure where m is 10.1.2.20. The header is read by the gateway node for example 10 and routed to the anchor node 8 because the address 10.1.2.20 lies in the advertised range. At the anchor node 8 (denoted as A1 in this figure), the packet 30 is encapsulated by adding in front of the header 32 a tunnel header 33. The tunnel header 33 includes a source address and a destination address. In this case the source address "Src" is the mobile address 10.1.2.20 denoted as "m" and the destination address is 172.17.1.1 denoted as "R1" in the figure. The encapsulated packet then travels the network to the access router 5. Note that the source address given in the tunnel header is that of the mobile node. The significance of this will be explained later.

At the access router 5 the tunnel header 33 is removed (depicted in the figure in broken outline) and the original packet 30 sent to the mobile node 4 over the wireless link.

Figure 4 shows the process in which a packet is sent from the mobile node 4 to the destination correspondent host CH. In a first step the mobile node 4 transmits a packet 40 over the wireless link to the access router 5. The packet 40 has a payload 41 and a header 42. The header 42 includes as before the source SRC and destination address. In this case the source is the mobile address denoted as m in the figure and the destination address is denoted as CH. This is received by the access router 5 and it encapsulates it in a tunnel header 43.

The tunnel header 43 includes a source address denoted as R1 in the figure and a destination address denoted as M that is to say the address of the mobile node 4. The packet will then be routed over the access network to arrive at the anchor node 8 this being the node that has advertised it "owns" the address of the mobile node 4. The anchor node 8 removes the tunnel header 43 and directs the packet 40 to the destination CH shown in the header of the original packet.

The significance of the tunnel header utilising as its destination address the address of the mobile will now be explained.

It will be noted that packets heading from the mobile node have a destination address of the mobile node once they have been encapsulated. The reason for this is that the packet will in the case of a packet leaving the mobile node be routed to the anchor node since it is this node that advertises that it handles packets destined for the mobile node. The advantage of this becomes clear when consideration is given to the situation of a mobile node leaving its current location in a network. Let us consider the situation of the mobile node leaving access router 5 in a handover

process to access router 6. The handover protocol results in the anchor node 8 being updated as to the new location of the mobile node 4. However, note that the access router 6 in dealing with packets originating from the mobile node does not need to be concerned with the address of the anchor. It merely packages an incoming packet with the tunnelling header inserting into the tunnelling header address the address of the mobile node. Placing the packet on the network will result in this packet being transmitted to the anchor node that has advertised that it caters for packets having that mobile node address. As a consequence there is no need for the signalling required to update nodes on the change in the path to the mobile node and the mobile node is allocated an address once when the mobile node first establishes connection to the access network providing that connection is maintained. A further advantage is that the mobile node does not require the address of the anchor node. This has advantageous implications for network security since it prevents user gaining a knowledge of the configuration of the network.

Claims

1. A communications network formed of interlinked network nodes the nodes including fixed nodes, at least one anchor node and, in use, at least one mobile node, at least one access node for facilitating connection of the mobile node to the network, means for allocating to the mobile node a network address, means for allocating addresses to particular anchor nodes, wherein the access node receives packets from the mobile node and encapsulates the packet in a packet having a header which shows as a destination address the address of the mobile node.

2. A network as claimed in claim 1 wherein the encapsulated packet traverses the network to the anchor node which is allocated to cater for communications involving the originating mobile node.

3. A network as claimed in claim 1 or claim 2 wherein the network nodes are informed as to the addresses serviced by the anchor nodes.

4. A network as claimed in claim 3 wherein the anchor nodes inform the network nodes as to the addresses serviced.

5. A network as claimed in any preceding claim wherein the anchor node receives the encapsulated packet and removes the encapsulation header, and then sends the original packet to the network.

6. A network node for use in a network as claimed in any preceding claim.

7. A method of directing packets in a communications network comprising:

allocating a network address to a mobile node;

assigning an anchor node to cater for communications with the mobile node;

informing the network of the anchor nodes assignment;

receiving a packet from a mobile node;

encapsulating the packet and providing an encapsulated packet header including a destination address being the address of the mobile node; and

transmitting the encapsulated packet over the network.

8. A method as claimed in claim 7 wherein the anchor node receives the encapsulated packet and removes the original packet from the encapsulation and transmits the original packet to the network.

9. A method as claimed in any preceding claim wherein the anchor node informs the network of its assignment.

10. An encapsulated packet produced by a method as claimed in any one of claims 7 to 9.

12. A communications network as hereinbefore described with reference to and or as illustrated by the drawings.

13. A method of directing packets in a communications network substantially as hereinbefore described with reference to and as illustrated by the drawing.

Application No: GB 0215194.2
Claims searched: 1-10, 12 and 13

Examiner: Emma Rendle
Date of search: 14 November 2002

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.T): H4L (LDGP, LRCMR, LRPLS, LRPMX)

Int Cl (Ed.7): H04Q 7/22, 7/24, 7/38; H04L 12/56

Other: Online: WPI, EPODOC, PAJ and ETSI and 3GPP Technical Specifications

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
A	GB 2 352 939 A (NEC) see whole document.	-
A	EP 1 102 509 A1 (NTT DoCoMo) see whole document.	-
X	WO 00/76171 A1 (NOKIA) see whole document, especially page 5 paragraph 4.	1, 2, 5, 6, 7, 8, 10
A	ETSI TS 100 927 V6.7.0 (2001-06), see whole specification, especially sections 2 and 3.	-
A	ETSI TS 123 003 V4.3.0 (2001-12), see whole specification especially sections 2 and 3.	-

X Document indicating lack of novelty or inventive step
Y Document indicating lack of inventive step if combined with one or more other documents of same category.
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